CONTRACT PROGRESS REPORT

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PROJECT DIRECTOR:	Thomas H. Milby, M.D.
PRINCIPAL INVESTIGATOR:	Dudley Porter Miller, Ph.D.

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COMMUNITY STUDIES ON PESTICIDES

Quarterly Progress Report #8 - December 16, 1966 - March 15, 1967
California State Department of Public Health
Bureau of Occupational Health

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ABSTRACT

During the period of this report, a survey of total agricultural input of pesticides in Kern County was completed and the results analyzed. Data are presented which show the amount of active ingredients applied to crop lands and the number of acres treated and, separately, active ingredients applied to noncrop lands by the county's Mosquito Abatement District. Together, these uses of pesticides account for 80% of the chemicals applied in Kern County during 1965.

A study of paranitrophenol and cholinesterase levels in mosquito abatement workers was completed. The results are compared with exposure levels for each worker as indicated by the total number of gallons of parathion and methyl parathion solutions he applied.

A case of environmental contamination resulting from the destruction of a nursery housing a variety of fertilizers and insecticides is described.

The laboratory activities during this quarter and, briefly, for the prior portion of this study are shown in outline form.

Urine samples from workers employed in a DDT manufacturing plant were collected and analyzed for DDA. Data gathered from this work are being forwarded to the Office of Pesticides.

Some of the proposed activities during the next quarter are discussed. These activities include a study of neonatal jaundice in Imperial County, an in-depth study of the health of DDT plant workers, and a study of persons exposed to lindane.

Project Reorganization

Effective March 1, 1967, a new Principal Investigator to the project was appointed. The project's work program has been rescheduled, work priorities established, staff activities reassigned, the project office in Berkeley reorganized, and a branch office for field staff established in Los Angeles in a portion of the quarters already under lease by the State Department of Public Health.

It is anticipated that the reorganization will facilitate a more rapid implementation of the project's work plans in the areas of its on-going and projected studies.

ACCIDENTAL PESTICIDAL CONTAMINATION OF ENVIRONMENT

On March 19, 1966, a fire at the Sanger Nursery located in the City of Sanger, California, which was started at the time of a burglary, totally destroyed the office, salesroom, and a portion of a storage shed. Stored in the shed were various amounts of chemical fertilizers and insecticides which, when dispersed by the heat and the application of water, caused contamination of waste water and vapors and engendered concern for the health of the contiguous public.

At the request of the Fresno County Health Officer, members of the California Department of Public, Bureau of Sanitary Engineering, and Community Studies on Pesticides, made a thorough investigation of the incident in an attempt to determine what preventive measures were and should be taken and what problems of public health importance remained.

An inventory of pesticides stored in the damaged area was obtained from the manager of the nursery. The protective measures taken by the firemen during the fire and the city sanitation workers during the subsequent cleanup operation were noted.

The waste water was considered toxic and was handled accordingly. Most of the water which collected was pumped into the domestic sewer line and deposited at the treatment plant and in the percolation ponds. Three days later, the plant effluent was sampled and examined by gas liquid chromatography and other techniques. No pesticides were found in detectable quantities.

While fighting the fire, firemen noticed that a cloud of smoke was produced which traveled southeasterly from the nursery. The smoke extended to ground level for a short distance, then rose to approximately 200 feet and continued about 3/4 of a mile southeast of the fire. The County Health Officer and Poison Control Center were contacted and, based on their recommendations, a warning notice was issued to the approximately 1,800 residents of the affected area.

Two days after the fire, soil samples were taken from the area near the fire, including the area where waste water had accumulated. Additional samples were taken throughout the area located in the downwind pattern from the nursery. These samples were analyzed by the laboratory of the Community Studies on Pesticides and by the State Spray Residue Laboratory. Results of these determinations indicated levels of 5.0 ppm DDT and 1.93 ppm parathion in the area where the water used to fight the fire had subsequently ponded. Levels for DDD, DDE, DDT, and parathion in the soil from the downwind areas ranged from 0.03 to 0.08 ppm. At various times since the fire, eight additional soil samples have been taken for analysis. Only in the case of the waste water area were detectable levels found.

A recent check with local physicians, the County Health Department, and the Poison Control Center located in Fresno indicated that no case of illness attributable to the effects of the fire-released chemicals has occurred.

The project staff is maintaining a file on this accident and will add to it any additional information as it is received. Furthermore, any other incidents of this nature will be investigated and a report kept on file.

AGRICULTURAL CHEMICAL INPUT - KERN COUNTY

FOR THE YEAR, 1965

The program to estimate the total input of agricultural chemicals applied to land under cultivation in Kern County is now complete. The data presented have, as their source, records of commercial applicators who are required by law to file a report of each operation with the Commissioner of Agriculture. With the cooperation of the Kern County Commissioner, the operators' records were reproduced and the data were transferred to IBM punch cards. By the use of appropriate computer programs, the total number of acres to which each chemical was applied and total quantity of each formulation used were calculated. From these data, the total quantity in pounds of active material was calculated for each chemical. For example, 4,497 gallons of Malathion 5E (5#/gal.) were used. Thus, 4,497 gal. x 5 lb./gal. = 22,485 lbs. of active material. These results are summarized in Table I.

It is estimated by the Agricultural Commissioner that these records of commercial applicators represent approximately 80% of the agricultural chemicals applied to crop land in Kern County.

Table II gives a summary of material applied by the Mosquito Abatement District for mosquito control during the year 1965. The records of individual control operations were duplicated and processed the same way as were the records of commercial applicators.

Since, in many cases, more than one chemical was applied to the same plot of land during a single treatment, the total acres to which several chemicals were applied is not the same as the total acres treated.

TABLE I

KIND AND AMOUNT OF AGRICULTURAL CHEMICALS
APPLIED IN KERN COUNTY TO CROP LAND BY COMMERCIAL OPERATORS
DURING THE YEAR 1965

Chemical	Use	Acres	Quantity (lbs. technical)
Sodium Chlorate	Defoliant	243,898	115,140
Thiodan HC	Insecticide	114,515	101,498
DDT HC	"	108,772	148,015 19.6%
Toxaphene HC	"	106,463	282,172
Dylox	"	98,241	89,622
Aramite	"	93,399	161,170
Magnesium Chlorate	Defoliant	85,584	466,376
Sulfur	Fungicide	82,502	1,394,234
Tedion HC	Insecticide	81,009	55,756
Dithane M-45	Fungicide	72,935	117,179
Guthion	Insecticide	65,166	49,531
Kelthane HC	"	59,300	70,612
Sevin	"	57,705	142,312
Methyl Parathion	"	54,550	39,516
Azodrin	"	52,551	48,145
Dibrom	"	49,577	32,393
Ethyl Parathion	"	46,992	60,647
Malathion	"	43,340	49,493
Bidrin	"	42,990	23,312
Endrin HC	"	29,019	15,537
Thimet	"	25,602	30,347
Oil	Herbicide	22,390	305,157
Systox	Insecticide	22,272	5,642
Sinox General	Herbicide	21,973	32,020
D.E.F.	Defoliant	20,406	25,350
Dithane M-22	Fumigant	15,938	26,470
Treflan HC	Herbicide	15,252	11,944
TEPP	Insecticide	12,115	4,806
Phosdrin	"	11,112	4,680
Urea	Fertilizer	10,982	465,072
Chlorobenzilate HC	Insecticide	10,234	13,324
Cygon	"	10,207	3,789
Diazinon	"	9,435	5,648
Meta-Systox	"	9,241	6,028
Phosphamadon	"	8,814	7,048
Thuricide (Bacillus thuringiensis berliner)	"	6,818	3,698
2-4, D* HC	Herbicide	6,600	5,044
Delnav	Insecticide	5,418	12,072
Polyram	Fungicide	5,191	564
Zineb	Fumigant	4,315	9,528
Captan HC	Fungicide	4,276	22,031

* Includes 2-4, D and 2-4, D Amine

TABLE I (continued)

Chemical	Use	Acres	Quantity (lbs. technical)
Simazine HC	Herbicide	3,005	18,775
Dinitro	"	2,854	161
Delmo Z (Zinc Sulfate)	Fertilizer	2,801	3,187
Ammonium Nitrate	"	2,780	167,659
Carbyne	Herbicide	2,038	640
Copper Sulfate	Fertilizer	1,692	19,638
Cytrol	Herbicide	1,414	16,610
Ethion	Insecticide	1,378	1,736
Hyvar X (Bromacil)	Herbicide	1,338	4,098
Trithion	Insecticide	1,033	1,002
Dieldrin HC	"	1,011	368
Karmex HC	Herbicide	988	4,814
Di-Syston	Insecticide	834	834
Paraquat	Herbicide	822	344
Dacthal HC	"	641	3,667
Sodium Arsenite	"	633	6,624
Caporal	"	633	1,013
Sabadilla Alkaloids	Insecticide	619	57
Folex	Defoliant	563	678
Eptam	Herbicide	505	1,512
Lorox HC	"	486	486
Promytrene	"	461	997
Ryno-Tox (Ryanodine)	Insecticide	400	3
Phygon	Herbicide	381	6,668
Pentachlorophenol HC	Defoliant	328	676
DDVP (Vapona)	Insecticide	261	80
Tillam	Herbicide	206	261
Ordram (Hydram)	"	178	534
Arsenic Trioxide	"	147	2,204
Nemagon HC	Fumigant	144	1,531
Ansar 560 (1)	Herbicide	137	474
Korlan	Insecticide	111	30
Dowpon HC	Herbicide	110	776
Sulfuric Acid	"	106	530
DD	Fumigant	106	1,060
Diquat	Herbicide	102	108
Chlordane HC	Insecticide	90	88
IPC	Herbicide	90	360
Ansar 184 (2)	"	88	222
Matacil	Insecticide	70	126

(1) Contains Sodium Cacodylate and Dimethyl Arsenic Acid

(2) Contains Disodium Methyl Arsenate

TABLE I (continued)

Chemical	Use	Acres	Quantity (lbs. technical)
Elgetol	Insecticide	63	49
Fly Killer D (Naled and Dibrom)	"	63	16
Morocide	Fungicide	63	126
Cryolite	Insecticide	62	1,004
Tordon 22K	Herbicide	55	67
Atrazine HC	"	52	1,126
Ansar 529 (3)	"	44	459
Ansar 170 (4)	"	40	100
Endothal	"	38	152
Enide (Dymid)	"	37	111
Pyramin	"	35	47
Karathane	Fungicide	25	10
Morestan	Insecticide	18	7
Banvel D HC	Herbicide	11	34
Amino Triazole	"	8	17
Baron	"	7	56
Sodium Metaborate	"	5	1,293
Sodium TCA (Sodium trichloroscetic acid)	"	3	285
Fenac HC	"	2	9
Trysben	"	2	48

Total Chlo. hydw: 753,469

(3) Contains Methanearsonic Acid

(4) Contains Monosodium Acid Methylarsenate

TABLE II

Chemicals Applied by the
Kern County Mosquito Abatement District for
Mosquito Control, 1965

Chemical	Acres	Quantity (lbs. active material)
Methyl Parathion	55,712	5,587
Baytex	3,992	400
Ethyl Parathion	3,887	366
Abate	130	13
Shell 7438	95	10

HEALTH STUDIES AMONG DDT PLANT WORKERS

In accordance with a plan submitted recently by the Project Director to and approved by the Office of Pesticides, an in-depth study of employees in a DDT manufacturing plant is in process of implementation.

The study anticipates a follow-up and extension of recent studies carried out at the plant by the U. S. Public Health Service and by the California pesticides study project. A further and more detailed report on the projected study will appear in a subsequent quarterly report.

In addition to the study of workers presently employed by the plant, the Office of Pesticides requested that the feasibility of a retrospective study covering former employees be examined.

Former employees number 1,129 workers of whom only 293 were employed more than six months. This latter group is relatively young, 85% of them being under 50 years of age. While their length of employment at the plant ranges from six months to nineteen years, the great majority of them worked two years or less. Sixty-six of these 293 former plant employees terminated employment within the last five years and most of them are thirty years of age or younger.

The period of time which has elapsed since the workers terminated employment at the plant is quite long (80% of them terminated more than five years ago). Furthermore, since the size of the group is small, it is unlikely that their morbidity and mortality experiences, even if well-documented, would prove statistically valid. Additionally, members of the proposed study group are low on the socio-economic scale and highly mobile, both job-wise and geographically. Consequently, the cost of locating them, securing essential information and data from them, and establishing access to their health records could be prohibitive and unproductive.

With all of the above facts in mind, the feasibility and productivity of a retrospective morbidity and mortality study of former employees of the DDT plant in question are not promising and the study is not recommended.

LABORATORY ACTIVITIES QUARTERLY REPORT #8

DECEMBER 15, 1966 TO MARCH 15, 1967

A. Work-Load Accomplishments

1. Obstetrical Sample Project

a. Samples submitted prior to report period - Forty-one placenta samples and forty umbilical cord samples have been submitted for chlorinated organic pesticide analysis.

b. Samples analyzed prior to report period - Analyses were completed for chlorinated organic pesticides on forty-one placenta and eleven umbilical cord samples. The remaining twenty-nine umbilical cord samples are being held in storage.

c. Samples submitted during report period - None.

d. Samples analyzed during report period - None.

2. Soil Samples

a. Samples submitted prior to report period - Fourteen soil samples collected at Sanger Nursery following a fire were submitted with a request for parathion analysis. Twenty-four samples from a Kern County cotton field were submitted with a request to analyze for chlorinated organic pesticides.

b. Samples analyzed prior to report period - Analyses were completed on the fourteen Sanger samples for parathion and on eight of the cottonfield samples for chlorinated organic pesticides.

c. Samples submitted during the report period - None.

d. Samples analyzed during report period - None.

3. Montrose DDT Project

a. Samples submitted prior to report period - One hundred and eighteen urine samples were submitted for DDA analyses prior to the report period.

b. Samples analyzed prior to report period - Analyses were completed on sixty-eight samples of urine for DDA prior to report period.

B. Developmental Work as Requested by Perrine

1. Quality Control Sample No. 1 (Prior to quarter; reported 12/9/66)

   a. Nature of sample - Iso-octane fortified with selected standard pesticides.

   b. Results of analysis:

Pesticide	Picograms per Microliter	Perrine Report of Deviation from Mean of all 16 Reports
Aldrin	52	2
OC-BHC	52	0
Y-BHC	55	5
Heptachlor	53	1
Heptachlor epoxide	57	4
p,p'-DDE	.53	8
o,p-DDD	301	14
p,p-DDT	307	6

2. Quality Control Sample No. 2 (reported 3/10/67)

   a. Nature of sample - corn oil fortified with selected standard pesticides.

   b. Results of analysis:

Pesticide	Micrograms/Gram	Perrine Report of Known Values
Heptachlor	0.01	(Not yet received)
p,p-DDE	0.18	
Dieldrin	0.05	
p,p-DDD	0.02	
p,p-DDT	0.28	

3. Evaluation of semi-Micro Method for Tissue Analyses as Requested by Dr. Enos.

   Dr. Henry Enos of the Pesticide Research Laboratory in Perrine has requested that we participate in evaluation of his method in which most parameters such as sample size and cleanup are fixed in detail. Some comparative results have been obtained by running samples by several methods. So far, the work has primarily been for familiarization. Some recovery data are also in process of being collected as well as time studies of the staff-time costs of the various procedures. An initial report of findings will be forwarded in the near future.

c. Samples submitted during the report period - There were no samples submitted on this project during this report period.

d. Samples analyzed during report period - Analyses of the final group of fifty urine samples for DDA were completed and the report submitted on January 6, 1967.

4. Mosquito Abatement District Parathion Study Project

a. Samples received prior to report period - A total of sixty-three (24-hour collection) urine samples were submitted for p-nitrophenol analyses.

b. Samples analyzed prior to report period - Thirty-one samples were analyzed for p-nitrophenol prior to the report period.

c. Samples submitted during report period - None.

d. Samples analyzed during report period - p-nitrophenol analyses were performed on the remaining thirty-two samples during the report period.

5. Autopsy Sample Study

a. Samples submitted prior to report period - Fifty-five samples of adipose tissue from the same number of subjects were submitted and thirty-two tissues (or organs) from three additional autopsied individuals were submitted for chlorinated pesticide analyses. In reference to samples from the three individuals, analyses were requested on only five tissues from one individual (kidney, liver, brain, testes and fat); for the other two individuals, analyses of the same organs plus bone marrow were requested. Thus, a total of seventeen of these selected tissues were to be analyzed and fifteen were to be stored.

b. Samples analyzed prior to report period - The fifty-five adipose tissue samples were analyzed for chlorinated pesticides prior to the report period.

c. Samples submitted during report period - Thirty-two selected tissues (or organs) from three individuals were submitted for analyses for chlorinated pesticides. Of these, analyses were requested on six tissues (or organs) from each individual (kidney, liver, brain, testes, fat and bone marrow) or a total of eighteen samples. Fourteen samples were for storage only.

d. Samples analyzed during report period - Analyses of 10 of 17 selected tissue samples received prior to the report period and 10 of the 18 selected tissue samples received during the report period are now in progress.

NEONATAL JAUNDICE - IMPERIAL COUNTY

In 1965, the Imperial County Medical Society brought to the attention of the California State Department of Public Health an apparently seasonal increase in the incidence of neonatal jaundice. The increased incidence appeared during the months of November and December and predominantly among male newborns. Local physicians, investigating possible environmental causes in the El Centro Community Hospital where the cases occurred, could not identify any particular agent used in the hospital as a possible cause. The physicians suggest that the increased incidence of the disease might be related to the use of cotton crop defoliants which are used almost exclusively during the latter months of the year, a necessary preparatory step in the use of mechanical cotton pickers.

The Bureau of Occupational Health of the California State Department of Public Health examined the birth records at the El Centro Community Hospital for 1965 and verified that an increased incidence had occurred, and was as described by local physicians. Subsequently, the Department's Bureau of Maternal and Child Health examined the hospital birth records for the years 1963 and 1964 and which paralleled the 1965 findings. The results of these studies are shown in Tables III and IV. An attempt was made to obtain similar data from hospitals in other communities in the county. Due to the inadequacy of the hospitals' records, however, valid conclusions could not be reached.

The information gained so far shows:

1. A marked increase in the incidence of neonatal jaundice in one population group in Imperial County during the months of November and December in each of three consecutive years;

2. In the judgement of certain local physicians, a relationship between the use of agricultural chemicals and neonatal jaundice appears entirely possible;

3. Imperial County is one of the most intensively farmed areas of the State;

4. The populated areas of the county are entirely surrounded by desert which greatly simplifies population morbidity studies.

We propose to carry this study forward during the current contract year in an effort to establish the relationship, if any, between the use of agricultural chemicals and neonatal jaundice.

The first steps in this process will be:

1. Continue our liaison with the county health officer, the local physicians and hospitals in the county by presenting the detailed findings of our work to date at an April, 1967, meeting;

2. Compare the incidence of neonatal jaundice in the study area with the incidence in other areas having similar agricultural practices as well as with urban areas where exposure to agricultural chemicals is minimal;

3. Carefully describe the agricultural chemical usage patterns in the study area over the past four or five years;

4. Assuming that the accumulation and study of data from the above steps will show promising leads, take the next logical steps which might include: environmental sampling; additional medical and biological studies; short studies of the disease when produced in laboratory animals.

It is important to note that Imperial County, California, presents study conditions which are unique to any other area in the United States. The climate makes intensive farming possible throughout the year. The populated area is surrounded by desert so that contact with and contamination by the outside world is restricted. It is below sea level with all drainage consequently into the Salton Sea, a landlocked body of salt water. Finally, being a desert, essentially all of the water supply is imported from the Colorado River via a few major aqueducts.

TABLE III

NUMBER OF LIVE BIRTHS WITH BILIRUBIN OF 10 MG AND OVER BY MONTH OF BIRTH AND SEX
EL CENTRO COMMUNITY HOSPITAL, IMPERIAL COUNTY, CALIFORNIA
1963-1965

MONTH OF BIRTH	1963			1964			1965		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Jan.	0	0	0	4	3	1	3	2	1
Feb.	1	0	1	1	0	1	1	0	1
Mar.	0	0	0	1	1	0	0	0	0
Apr.	0	0	0	2	1	1	2	1	1
May	1	1	0	1	1	0	4	4	0
June	0	0	0	0	0	0	1	1	0
July	0	0	0	7	4	3	3	2	1
Aug.	1	1	0	1	0	1	3	1	2
Sept.	1	0	1	2	2	0	1	1	0
Oct.	4	2	2	2	1	1	2	1	1
Nov.	2	0	2	1	0	1	9	8	1
Dec.	6	2	4	6	6	0	9	3	6
Total	16	6	10	28	19	9	38	24	14

TABLE IV

LIVE BIRTHS WITH BILIRUBIN LEVELS OF 10 MG AND OVER BY SEASON (QUARTER) OF BIRTH AND SEX, EL CENTRO COMMUNITY HOSPITAL, IMPERIAL COUNTY

1963-1965

SEX AND SEASON OF BIRTHS	NUMBER OF LIVE BIRTHS BY BILIRUBIN LEVEL					
	10-12 MG		12-13 MG		13 MG and Over	
	Observed	Expected[1]	Observed	Expected[1]	Observed	Expected[1]
Both Sexes	82	82.0	61	61.0	51	51.0
Jan. - Mar.	11	20.2	9	15.0	8	12.5
Apr. - June	11	18.1	8	13.5	8	11.3
July - Sept.	19	22.1	12	16.4	8	13.7
Oct. - Dec.	41	21.6	32	16.1	27	13.5
	χ^2 =	24.8*	χ^2 =	21.5*	χ^2 =	18.5*
Male	49	48.9	37	36.9	32	32.0
Jan. - Mar.	6	12.2	5	9.2	5	8.0
Apr. - June	9	11.6	6	8.7	6	7.6
July - Sept.	11	14.5	7	11.0	5	9.5
Oct. - Dec.	23	10.6	19	8.0	16	6.9
	χ^2=	19.1*	χ^2=	19.3*	χ^2 =	15.6*
Female	33	33.0	24	23.9	19	19.0
Jan. - Mar.	5	8.0	4	5.8	3	4.6
Apr. - June	2	6.8	2	4.9	2	3.9
July - Sept.	8	8.0	5	5.8	3	4.6
Oct. - Dec.	18	10.2	13	7.4	11	5.9
	χ^2 =	10.5**	χ^2 =	6.6	χ^2 =	6.4

[1] Expected numbers are based on the percent distribution of total live births by season (quarter) of birth for each sex in El Centro Community Hospital, 1963-1965.

* Significant at the 99% confidence level.

** Significant at the 90% confidence level.

OCCUPATIONAL EXPOSURE TO LINDANE

Since 1954, lindane vapor exposure has been a subject of considerable interest as a possible etiological agent in serious blood dyscrasias, primarily aplastic anemia. To date, however, no systematic investigations into this possible relationship have been carried out. In certain areas of California, appliances which continuously release vaporized lindane into the work area are in routine use. A more common and possibly more hazardous practice is the periodic spraying of lindane by pest control experts in private homes.

Blood dyscrasias are relatively rare and apparently dependent upon a particular set of individual circumstances not existing in a large number of individuals. In California, there is a death rate of approximately 0.4 per hundred thousand per year in which aplastic anemia or related blood dyscrasias are implicated in some way. If exposure to lindane increased the death rate from this cause tenfold, there would still be only four cases per one hundred thousand of such exposed individuals. It is quite obvious that no statistically significant evidence of an increase of this magnitude could be obtained by observing less than one hundred thousand exposed individuals. Consequently, this approach is not feasible.

Instead, an intensive epidemiological study of about 200 subjects with measurable exposure is planned. It is designed to explore, through careful and systematic collections and analyses of biological and correlative data, the very early biochemical changes which indicate developing pathology.

Currently, the project's field investigators are locating a study population working in an environment which subjects them to a continuous exposure to lindane vapor. Concurrently, the project staff is developing sampling procedures to study the levels and details of lindane exposure. Subcontract arrangements with a hematologist to furnish the clinical laboratory and diagnostic services essential to the study are being negotiated.

PARANITROPHENOL AND CHOLINESTERASE LEVELS

IN MOSQUITO ABATEMENT WORKERS

This study was planned, executed and completed prior to the expiration of the 1966 contract. With the following summary, this work is considered closed.

The Kern County Mosquito Abatement District, with headquarters in Bakersfield, employs about 40 men in the application of the organophosphate compounds, parathion and methyl parathion, for mosquito control. These materials have been used almost exclusively since 1955. The district uses annually a total of about 6,000 pounds of these two chemicals.

Each worker was asked to contribute a 24-hour urine sample early in May, 1966, about one week prior to the start of the mosquito control season. The samples were shipped to our Berkeley laboratory and analyzed for the presence and amount of urinary paranitrophenol, a metabolite formed in the body from both parathion and methyl parathion.

Due to the fact that parathion and methyl parathion are rapidly metabolized and excreted as paranitrophenol by humans, it is imperative that the tests be conducted during a working day and, if possible, during a day near the end of the work week. Therefore, each worker contributed another sample during a work day in August, the height of the control season. These samples were also analyzed for paranitrophenol, the analyses being completed during the period covered by this report.

Cholinesterase levels, both plasma CHE and red blood cell ACHE, were determined on each worker as a routine procedure prior to starting the control season and the height of the season. These tests were conducted at the Central California Medical Laboratories in Bakersfield using the Michel Electrometric Method for analysis. The results of these tests were made available to the staff of the pesticide study.

The amount of spray solution applied by each man during the control season was obtained from the files of the Mosquito Abatement District. The spray solution, either parathion or methyl parathion, was applied at a concentration of one pound of actual material per one hundred gallons of water. Each worker used the same type of "Jeep"-mounted power sprayer equipment.

Thirty-two workers volunteered to contribute urine samples. The results of this study appear in Table V. Each of the 32 workers is ranked in order of decreasing number of gallons of spray solution he applied during the control season. The urinary paranitrophenol levels are given in terms of the total micrograms of material in the total sample collected.

Cholinesterase levels given are for plasma CHE expressed as delta pH units per hour. As shown in the table, only 20 of the subjects completed the two seasonal cholinesterase determinations.

The results indicate that the men who applied the greater number of gallons of insecticide, i.e., those ranked 1 through 16, showed a greater increase in urinary paranitrophenol levels (8 out of 16) than did those workers, ranked 17 through 32, who applied fewer gallons, wherein only 4 of the 16 showed an increase in the number of micrograms of urinary paranitrophenol. Seven workers had detectable amounts of paranitrophenol present in their urine samples prior to the mosquito control season. In each of the seven cases, the workers had been engaged during the early spring in handling insecticides, including parathion; or, during this period, the worker had been working for the Mosquito Abatement District at such tasks as cleaning and repairing spray equipment, sorting and loading bags of insecticide, or, as in the case of worker number 28, working with the dinitrophenol herbicides used only during the early spring.

Using the arbitrary figure that cholinesterase activity 25 percent below the pre-exposure level is an indication of pesticide action, it can be seen that one worker in each of the high and low exposure groups falls into this category. In each of these cases, the decrease in cholinesterase activity does not correspond with changes in the urinary paranitrophenol levels.

Among workers receiving both cholineterase tests, the enzyme levels among workers who had no detectable pre-exposure paranitrophenol, failed to show greater than 25 percent inhibition, even though paranitrophenol was detected in the second test. Apparently, the levels of exposure, resulting in detectable urinary paranitrophenol, are not sufficient to inhibit cholinesterase activity. Worker number 19, who did not use parathion or methyl parathion in the course of his work, had no detectable paranitrophenol, but had greater than 25 percent cholinesterase inhibition. A check of this worker indicated he had used other insecticides during the summer which were not in connection with his work for the Mosquito Abatement District. While he could not recall which material he used, it apparently was an organophosphate but not parathion, methyl parathion, or any other material forming the paranitrophenol metabolite.

From this study, it appears that while there is some evidence that urinary paranitrophenol levels may be used to estimate the degree of exposure to parathion or methyl parathion among groups of workers in epidemiological studies, its value as a clinical indicator of exposure of individuals must be looked upon guardedly.

TABLE V

Paranitrophenol and Cholinesterase Levels
in Mosquito Abatement Workers
Exposed to Parathion and Methyl Parathion

Worker Number	Rank No.	Gallons Sprayed[1]	Total ug. of Paranitrophenol in 24-hr. Urine Sample		Cholinesterase (Plasma) Levels	
			Pre-Exposure	During Exposure	Pre-Exposure	During Exposure
26	1	14,722	NF[2]	63	--	0.66
27	2	13,317	NF	NF	0.87	--
1	3	12,469	NF	NF	0.88	0.79
11	4	10,424	NF	82	1.37	1.30
22	5	10,414	180	147	0.74	--
2	6	8,932	150	146	1.04	1.21
4	7	7,627	56	158	1.00	1.20
15	8	6,223	NF	NF	0.51	0.86
20	9	5,900	75	41	0.51	0.29
6	10	5,564	NF	352	--	0.99
14	11	4,584	NF	82	1.07	0.99
8	12	4,474	NF	214	--	0.79
10	13	4,474	NF	116	1.09	1.03
12	14	4,344	NF	NF	0.87	--
9	15	4,035	NF	NF	1.11	1.15
7	16	3,922	NF	80	1.04	--
18	17	3,234	NF	32	0.64	0.54
5	18	2,830	NF	NF	0.76	0.86
16	19	2,821	NF	83	0.99	1.15
17	20	2,615	47	NF	0.91	0.97
21	21	2,427	72	253	0.62	0.51
25	22	1,419	NF	NF	--	1.03
24	23	1,107	NF	NF	0.81	--
13	24	1,053	NF	NF	0.79	0.99
23	25	679	NF	NF	0.89	--
3	26	604	NF	146	0.96	1.15
19	27	0	NF	NF	0.99	0.54
28	28	0	800	NF	0.79	--
29	29	0	NF	NF	0.84	1.03
30	30	0	NF	NF	0.92	0.89
31	31	0	NF	NF	0.61	--
32	32	0	NF	NF	1.04	1.15

[1] Each gallon contained 1/100 lb. methyl parathion or ethyl parathion.

[2] "NF" means none found: that is to say, PNP, if present, is less than 0.04 ppm, the limit of detection.